The ICSM ePlan Protocol, Its Development, Evolution and Implementation.

Nevil CUMERFORD, Australia

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SUMMARY

The lodgment of digital cadastral data is seen by many as the next great paradigm shift in the management of surveying records, the question is how do we get there, how do we manage the process and how do we use existing relationships between stakeholders to make it a reality.

Since 2003 the Intergovernmental Committee for Surveying and Mapping (ICSM) has sponsored a working party to develop a Digital Cadastral Survey Information Transfer Protocol to allow for consistent transfer of cadastral survey data between the surveying entities and the jurisdiction.

The ICSM ePlan Protocol was ratified in November 2009 and released to the survey software vendors so that they could develop the tools required by the surveying industry to take advantage of increased efficiencies offered by digital submission of survey data.

This paper takes an historical view of the development of the protocol and introduces the major elements of the protocol and references the location of these documents.

The paper also looks at the implementation of the protocol within several Australian Jurisdictions and looks at some of the future challenges relating to digital lodgment.

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1. INTRODUCTION

The lodgment of digital cadastral data is seen by many as the next great paradigm shift in the management of surveying records, the question is how do we get there, how do we manage the process and how do we use existing relationships between stakeholders to make it a reality. And most importantly of all, how do we leverage existing investment by governments, survey industries and their suppliers to create better value within the cadastral survey life cycle.

The Intergovernmental Committee for Surveying and Mapping (ICSM) (www.icsm.gov.au) is the peak body in Australia and New Zealand for the coordination and development of Standards for Spatial Industry Practice. The committee evolved from the National Mapping Council set up in the 1960's for coordinating the National Mapping Program. In the Late 1980's it was realized that the focus of the group also involved the development of operational standards within the spatial industry and in 2002 became a Standing Committee to the Australian and New Zealand Land Information Council (ANZLIC). Some of the major bodies of work undertaken include:

- The Harmonized Data Framework for Australia
- Surveying Standards and Practices (SP1)
- Australia Spatial Data Infrastructure (ASDI)
- Cadastral Reform
- Street Addressing Standards

The Committee comprises representatives from Commonwealth, State and Territory Agencies from Australia and New Zealand involved in the collection and maintenance of Spatial Data.

In 2003 Queensland had begun work on the development of a digital transfer protocol for cadastral survey data and had initialized the Electronic Access for Registry Lodgment (EARL) Program. The fundamental outcome of the project was to develop a transfer protocol and procedure to undertake all of the current business practices associated with a paper cadastral plan. This extended beyond the basic vector data currently associated with cadastral mapping and included the use of the data for

- Development Approvals
- Survey Auditing
- Automated updates to plan and survey indices
- Title creation
- Valuation Splits
- Digital Cadastral Update
- Land Tax processes
- Development Forecasting

- Street Addressing

This early work identified 3 major stakeholder groups:
- The Local and State Agencies
- The Surveying Profession
- Software Vendors to the surveying profession

During consultation with the surveying profession it was identified that the creation of the cadastral survey plan, though seen by government agencies as highly important, was a fairly minor process in the design, approval, development and execution of the land development cycle but was often the most problematic. The Surveying Profession had clear views on the project which included:
- The Land Development process was a value adding cycle and as such the industry wanted to access base level digital data to which they could add value.
- Most surveying entities where highly automated through the design, capture, setout and as constructed phases but were relying on paper records for initial data and final presentations which introduced added complexity, additional workload and the potential for the introduction of errors in the final product.
- Most surveying entities had well defined relationships with software vendors and did not want to see the introduction of further processing software and would like to see existing software modified to produce any digital output required by the agency.

The project then approached the software vendors whose main messages were:
- Do not create your own standard but to work within an existing internationally accepted standard.
- The Queensland Market was very small and it would be more economically feasible for the vendors to support the protocol if it was nationally accepted and other jurisdictions made a commitment to use the protocol.

The EARL Project then approached the ICSM via its jurisdictional member to investigate the potential for developing an Australasian Standard for the transfer of digital cadastral data. The first meeting of the ePlan Working Group was held in November 2003 in Brisbane.

2. HISTORY OF THE EPLAN WORKING GROUP

The ePlan working group was formed at the meeting and subsequently ratified by the ICSM. All jurisdictions expressed an interest in moving to digital lodgment of cadastral survey data but it was recognized that each jurisdiction had a well defined set of business practices and an operational system therefore it was decided that the working group could only look at the transfer protocol with individual internal implementations being the responsibility of the jurisdictions.

One of the issues identified during the consultation process was the use of differing terminology for similar processes and objects in the different jurisdictions. At an early stage

it was realized that the final protocol would need to be customizable for each jurisdiction. For example, the terms Building Format, Strata and Stratum plans were used to identify a similar plan for a strata unit development all with similar content and rules.

Another term which was used synonymously was "electronic" and "digital" and it was found that the two terms needed to be differentiated. The working group accepted that "electronic" lodgment meant the electronic transfer of a document that needed interpretation, for example, the online lodgment of a pdf of a plan. The plan was received electronically but the document still needed human interpretation. The meaning of a digital lodgment came to refer to the electronic lodgment of intelligent digital data, for example, by xml.

The working group had the following main terms of reference:

- Produce a generic UML model for a cadastral survey. The model must allow for the ability to harmonise with existing ICSM and ARECSC eConveyancing models as well as the New Zealand eSurvey and eDealing models,
- The Model must handle both the spatial and legal functions of the plan,
- The Model must facilitate the update of cadastral mapping systems, survey indexes and searching tools, as well as survey control data sets and street address data sets, and allow for generic and jurisdictional specific elements to be added.
- Develop or identify standard tools based on the generic UML schema that would facilitate data capture, visualisation and validation functions with the ability for adaptation for specific jurisdictional requirements.
- Develop a high-level business case for the adoption of an ePlan standard.

The working group developed the logical models in 2004-2005 and investigated suitable international standards to apply to the model to develop a physical implementation of the model.

Not one existing transfer standard fully supported the model and since the New Zealand LandOnline system had adopted LandXML 1.0 for its transfer standard, the working group looked closly at LandXML (www.landxml.org). At the time of development LandXML was preparing for the release of LandXML1.1 and with input from the working group modified LandXML to support the ePlan Model. LandXML1.1 was released in July 2006 and fully supported the ePlan model.

A challenge was that until a reference implementation of the ePlan model was operational that could perform all of the functionality of the model, limited support from the surveying industry, vendors and the individual jurisdiction could be expected.

The Department of Environment and Resource Management (DERM) in Queensland through the EARL Project developed a reference implementation of the model to prove its viability. The first stage of the Earl Project developed a data capture tool called the Survey Information Proceesor (SIP) and a number of web services used to validate and manage the digital data. The project developed processes to:

- Validate the survey data, the first stage of the project implemented about 70 validation rules which could be automatically applied to the survey data which dealt with the survey and administraive data associated with the survey.
- Automate update tools for survey related indices for the lodgement of digital data
- Automate update of the survey control data sets from the digital file

- Interface with corporate data storage system
- Automate data entry to the Digital Cadastral Database (DCDB) for management of casdastral boundary data..

At the time of writing 95% of all cadastral surveys lodged in Queensland are captured into the ePlan Protocol using the SIP tool which assists in plan auditing and survey data processing as well as updating the DCDB. This work has proven the effectiveness of digital processing and has improved the quality of the data in the corporate sytems and improved efficency in both survey plan auditing and handling and update of the DCDB. Research has also been undertaken into the use of the digital survey data for numeric upgrade of the DCDB.

The work in Queensland as well as work in New South Wales using the ESRI suite of products has proven the robustness and adaptability of the model.

With this work the ICSM was confident that the model will suit its requirements and on 20 November 2009 release the ICSM ePlan protocol the the survey software vendors for the development of tools for use in the surveying industry.

One of the interesting debates was "What do we call a LandXML consistent XML document of a digital cadastral survey that was compliant with the ePlan protocol?" All jurisdictions called the existing cadastral documents "plans" which it clearly was not and this term always brought debate back to existing procedures, presentation styles and traditional processing methods which at times was unproductive. It was therefore found to be beneficial to create a new term to describe this new digital object. The term "Cadastral Information File" or CIF was developed to describe this object. This then means that the Visualization of a CIF is a plan, the outcome of a CIF Validation is a Validation Report, etc.

As part of the communication strategy the working group established a collaboration site to allow access to documents, examples, etc. This is the ICSM ePlan Working Group area of the Australia Federal Government GOVDEX web site. Users can access this site using the following link.

Home - ICSM ePlan Working Group - GovDex

3. THE ePLAN PROTOCOL

There are several objects which support the protocol, each of these objects are closely linked to the others and managed conjointly.

3.1 The ePlan Model

The ePlan Model is a set of UML Class diagrams which describes the data contained within a cadastral survey. This model is the logical model of the cadastral survey and is initially used to give an understanding of the model from a surveyor's perspective. The model is a generic model and is not implementation specific. The model also identifies mandatory and optional data and the relationships between the data elements.

The model is also important in that if a future international standard is proposed for the transfer of the cadastral data then this model can be used to assess this standard for the Australian condition to enable informed debate.

It was recognized that there are many tools which could create an XML Schema directly from the model but that would have required the software vendors to support a local standard. Since the major developers of survey software are international it was not feasible to follow this path.

It should also be recognized that the model created also needed to support the New Zealand work with LandOnline. New Zealand was using LandXML1.0 to support the transfer of reduced survey observations and monument information to the LandOnline system, other Titling and Administrative data was supplied and manipulated within LandOnline. Since the model needed to support these functions the ePlan model became a superset of the New Zealand Model.

The model is described in "The ePlan Model" Version 1 (ICSM 2009)

3.2 The Standard

The standard could be any internationally adopted standard for the transfer of data that could be used to support the model. After investigation LandXML was selected, this was mainly suggested from two areas. Firstly New Zealand had significant input into the development of LandXML1.0 particularly in the area of observations and monumentation for cadastral survey. New Zealand also had a model that was working, adopted by industry and moving towards mandatory digital lodgment. Also the feedback from the software vendors was that most software vendors active in Australia were supporting LandXML1.0 in New Zealand and a strong suggestion from them was that if LandXML was adopted the development required to support the ePlan Model would be significantly reduced.

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One of the major issues we had with LandXML was that it was mainly based on US terms and enumerations and to modify the model for simple changes to enumerations would have been an ongoing maintenance issue. This was overcome by working with LandXML and introducing local schemas that could overwrite defined xml types in the parent schema, this allows a jurisdiction to develop and publish local enumerations as required.

Due to normal maintenance of LandXML its current version is 1.2 and this version was selected for the final release of the protocol. LandXML1.2 is backwardly compatible to LandXML1.1.

The LandXML1.2 schema (2008) is available from the LandXML Website (www.landxml.org)

3.3 The ePlan Protocol

The ePlan Protocol can best be described as the physical implementation of the ePlan Model using LandXML1.2. There were several challenges in developing the protocol.

Firstly the ePlan model identified mandatory elements which were optional within LandXML but also there are elements within LandXML that are not used in ePlan.

Secondly there are constraints in LandXML that do not appear in the ePlan model. For example to associate an observation between two points an intermediate element for an instrument setup is required (a LandXML Constraint) but an instrument setup for a series of reduced observations is not logical within the ePlan Model.

Thirdly within LandXML several different methods could be used to achieve the same outcome so the protocol needed to define how to use LandXML to achieve the outcome desired or where a specific combination of elements are required to describe a specific requirement, for example, to describe a non statutory easement, its conditions and the parties.

The protocol is described in the document "ePlan Protocol" Version 1.2 (ICSM 2009)

3.4 Jurisdictional Schemas

The fourth element is the definition of a series of complementary schema or xml instances that work in conjunction with the LandXML Schema to allow for jurisdictional customization and standardization. There are 4 xml documents that are required. The format of these documents are managed via the ICSM so that vendors can expect data presented in a consistent manner. These four schemas include:

Enumerations.

Enumerations can be specific to a jurisdiction and may be fairly dynamic and change with changes to work practices. This schema contains a series of XML types which can have enumerations (pick lists) associated with them. These types are defined in LandXML as a simple string to satisfy the LandXML Validation but the local schema defines the required values. Examples of types of elements that are defined here are:

- **Head of Power** this is the legislation under which the survey is being prepared. This is a jurisdictional specific element and is important as the legislation and its regulations determine the business rules to be applied to the survey. For example a survey prepared under the Queensland Legislation of "The Land Act of 1994" differ from "The Land Title Act of 1994" and importantly if new legislation is implemented business rules may change.
- **Administrative Boundaries** allows the jurisdiction to define what administrative boundaries are required in a specific jurisdiction, for example, the original LandXML only allowed for county however in Queensland, for example, we have Local Authorities, Localities, Parishes, Counties and Mining Districts amongst others. This also allows for flexibility if, for example, new restrictions are enforced within certain

environmentally sensitive areas the jurisdiction could be set up a new set of administrative areas to allow specific business rules to be implemented in such areas.
- **Parcel Class** defines what a parcel was created for, for example Lot, Easement, Lease etc but again this is defined by local practice.

Administrative Area Schema

Within the enumerations schema a series of Administrative Areas can be defined, this xml document creates the definitive list of the actual Administrative Areas for example it can list of the Localities within a jurisdiction. This proves not only a pick list to choose the correct locality but also offers a list with some basic relationships for data validation. This list is fairly dynamic with regular changes that can be managed by the jurisdiction.

Certificates

The certificates file provides XML templates to e completed so that certificates, compliant with the relevant legislation (head of power), can be completed by the user and verified by the plan auditing process. This file is fairly static and often changes with regulatory updates.

Annotations

The are many annotations, action statements and notations required on a cadastral survey often related to specific legislative requires (ie Road to be Open, Compilation Statements etc). These statements need to be in a specific format but also specific content of the statements may need to be validated. This file gives the structure of the statements so that they can be compiled correctly and that auditing processes can verify the result.

The architecture and content of these schemas is described in "CIF Schema Architecture" v1.0 (ICSM 2009)

4. VERIFICATION AND VALIDATION

Although not part of the protocol a look at verification and validation procedures will demonstrate how the elements of the protocol work together.

A jurisdictions survey auditing process can often apply several hundred rules to a survey during auditing. These rules are associated with the jurisdictions survey standards and practices and can be divided into two broad groups. Those that can be codified and can hence be applied to the digital data, examples of these types of rules are, the dimensions of a parcel must be complete, the parcel must close to a specified tolerances, the corners must be marked in a specific way. Then there are subjective rules which need human interpretation, for example, is a reinstatement logical, has an irregular boundary been determined correctly, etc.

A future break down of these rules can be defined as internal or external rules. An internal rule only deals with the content of the survey (i.e. the CIF). These types of rules are, for

example, the plan description creates three lots can three created lots with those names be found, do the lots have areas, is that areas correct. These rules define the internal quality of the survey. A external rule tests the new survey against existing data, for example, does the lot that this survey subdivides exist, was the surveyor performing the survey licensed at the time of the survey. These rules provide the external conditions for the survey.

Therefore a CIF could be submitted but prior to submission the following Verification and Validation can be performed prior to acceptance of the survey:

- Is the CIF compliant with the W3C XML standard (International)
- Is the CIF compliant with the LandXML schema (International)
- Is the CIF compliant with the ePlan Protocol (Australasian)
- Do the elements provided agree with published lists (Jurisdictional Schemas)
- Is the CIF internally consistent (internal validation rules)
- Is the CIF consistent with existing cadastral data (external validation rules)

If these statements can be satisfied then the survey need only be checked for subjective rules such as reinstatement, determination of irregular boundaries, etc.

For a detailed look at a jurisdictional validation process see "EARLII Logical Design validate CIF" (DERM 2009)

5. GOVERNANCE

During the establishment of the protocol it was recognized that there were several significant stakeholder groups which would need to make significant investment to implement digital lodgment. This included the jurisdictions, the surveying industry, software vendors to the surveying industry and other users of cadastral survey data. To ensure that proper debate and implementation of any proposed changes to the protocol a Governance framework within the ICSM needed to be established. The framework has been established by the ICSM and is published in the "ePlan Governance v1.0" (ICSM 2009).

6. IMPLEMENTATION

A draft version of the protocol was released in March 2009 for comment by the survey software vendor community and after receiving feedback the protocol was ratified by the ICSM at its meeting in Melbourne. The final documents were presented to the vendor community on 20 November 2009. Several vendors have produced sample files for beta testing and most vendors active in Australia have expressed their support.

At the time of writing significant work was being undertaken by the jurisdictions in Australia.

Queensland

The SIP Process, as discussed, earlier is capturing and processing 95% of survey lodgments and being audited using digital techniques. The system also updates the survey plan and survey control indices.

The EARLII project is underway developing nine web services for remote validation, submission and visualization of CIF. The project will also increase the number of validation rules from 70 to 170 including both internal and external rules.

Queensland has published its jurisdictional schemas and is hoping to receive plans from the survey industry in late 2010.

Testing of output from several vendors has been undertaken and will increase in 2010.

New South Wales

New South Wales has several projects running to implement the lodgment of ePlan. The most significant being the development of a lodgment portal for the receipt of digital plan.

New South Wales is utilizing the ESRI suite of products and is developing an interface between the CIF and the ESRI Cadastral Editor product. New South Wales are using ESRI Cadastral Editor to digitally process CIF for plan auditing. New South Wales has codified its business rules and published its jurisdictional schemas. New South Wales is hoping to beta test external submission by the surveying industry by 3rd quarter 2010.

Victoria

Victoria is currently codifying its business rules and publishing its jurisdictional schemas and designing the interface between the CIF and its "Streamlined Planning through Electronic Applications and Referrals" (SPEAR) lodgment portal. They are hoping for beta testing of digital data submission 3rd quarter 2010.

Smaller states are analyzing their business processes and looking at the impacts of digital submission within the framework of modernizing their cadastral records systems.

7. FUTURE CHALLENGES

Support of the software vendor industry to adopt the protocol and, in conjunction with the vendors, provide training and assistance to the industry to adopt the standard.

The current ePlan protocol has been exercised rigorously over the last several years primarily with the traditional 2D survey world. The ePlan model has been designed to support 3D surveys which include Volumetric and Strata (Building) surveys. These types of surveys can be prepared with the current protocol but have not been fully exercised.

A challenge of the 3D world is developing business routines for testing and verifying 3D objects. It is a fairly simple test for accuracy of 2D parcels, for example, does the parcel close, but in the 3D world, tests for planarity and the completeness of the solid become more challenging.

The use of digital data goes beyond the vectors on a plan and the use of the digital data, for example, to create new title interests or create valuation records, economic forecasting and other uses for the digital data that have not yet been realized will provide a challenge.

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BIOGRAPHICAL NOTES

Nevil Cumerford is a Cadastral Surveyor with the Department of Environment and Resource Management in Queensland Australia with the Spatial and Scientific Systems Area of the Spatial Information Group. He has been working in the development of Corporate IT Systems for the Management of Survey Data for over 20 years. He is currently the team leader for the Electronic Access for Registry Lodgment Program for the Department. He is a member of the Surveying and Spatial Science Institute of Australia (SSSI).

CONTACTS

Mr. Nevil Cumerford
Department of Environment and Resource Management
Level 9, Landcentre.
Cnr Main & Vulture Streets
Woolloongabba
Brisbane
AUSTRALIA
Tel. +61 7 389 63213
Fax + 61 7 34062361
Email: nevil.cumerford@derm.qld.gov.au
Web site: www.derm.qld.gov.au

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The ICSM ePlan Protocol

Building Capacity Through Cooperation

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Fundamentals

Had to perform all of the functions of a current paper plan.

Could not dictate the processes or systems used by individual jurisdictions.

Had to be customisable by a jurisdiction for local conditions.

Needed to employ industry standards in its development.

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5 Components

The ICSM ePlan Model

- A UML Class Diagram of a Cadastral Survey
- The Logical Model

The Standard

- LandXML1.2 from LandXML.org

Jurisdictional Schemas

The Protocol

- The ePlan Model mapped to LandXML1.2
- The Physical Model

Governance Model

- How to Maintain the Model

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Time Lines

Model Ratified by ICSM 2007

Model Exercised by Queensland 2005

Internal Operation in Queensland since 2005

Update of Internal Survey Systems QLD

Protocol Released to Vendors Oct 2009

Juridcitional Schemas available for NSW, QLD, VIC

QLD developing web services for search and submission 3rd Q 2010

NSW internal Capture process in pilot

Victoria developing interface to SPEARS

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Capability of ePlan

Supply of intelligent survey search

Online Validation of survey data (about 95%) of validation rules

Automatic update of survey systems including DCDB

Input for numerical adjustment of DCDB

Auto generation of new titles

Assisted update of valuation systems

Direct input for statistical research

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Thank You

ICSM website

www.icsm.gov.au

ePlan Documents

www.icsm.gov.au/iscm/ePlan/index.html

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